4-15-2016

Investigating the After-Effects of Stochastic Resonance for Use in Laparoscopic Surgery

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Laparoscopic surgery is a modern surgical technique in which surgeons insert tools through small incisions in the abdomen to perform a surgical procedure. Surgeons typically have only limited 2D visual feedback based on a small camera that is inserted into the abdomen, and minimal haptic feedback that is transmitted through the rigid surgical tools. It is difficult for surgeons to detect subthreshold haptic feedback that surgical instruments transfer onto their hands. Research has shown that Stochastic Resonance (SR), which is the phenomenon of introducing white noise into a nonlinear system to enhance the detection of subthreshold stimuli, is capable of increasing the sensitivity of surgeons' hands and, therefore, improving their detection of embedded tumors during simulated laparoscopic surgery. There is evidence to suggest that an after-effect of SR exists long after the application of the white noise. However, not much work has been done to quantify the extent of the SR after-effect on users, and specifically, on surgeons. Our objective is to measure the extent of SR after-effect after a prolonged SR application in the form of a vibration signal. The results obtained from this research will allow us to design an effective enabling technology that applies SR in clinical settings, enhancing the sensitivity and performance of surgeons in laparoscopic surgery.